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INTERRELATIONSHIP BETWEEN SHADOW PRICES,
PROJECT INVESTMENT AND POLICY REFORMS
- AN ANALYTICAL FRAMEWORK

by

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FOREWORD

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I. INTRODUCTION

1. The purpose of project evaluation is to provide a consistent procedure for choosing among alternative investment decisions. Profits are an essential signalling mechanism in this regard and public profitability is measured in shadow prices. A shadow price is defined as the net impact on social welfare resulting from a unit increase in the supply of a good or service by the public sector. Thus, a project that shows a profit at these shadow prices will make a positive contribution to social welfare. welfare
or
growth

2. The evaluation of public sector projects in developing countries was the focus of a major research effort in the 1970s for a number of reasons.^{1/} Given the high share of public sector investment in total investment, its efficient use was desirable. In addition, the existence of significant market imperfections in developing countries made it all the more necessary to use shadow prices in public investment decisions. Consequently, major methodological and empirical research initiatives were launched to estimate shadow prices.^{2/} The literature on project evaluation that emerged in the 1970s was based on the ceteris paribus assumption that existing policy distortions would continue into the future. The rationale for this stemmed from two considerations. First, a project's output would constitute a marginal increment and hence no policy changes could be expected from undertaking a single project. Second, the evaluator's role is relatively limited and hence the general policy environment is taken as given.^{3/}

3. The advent of the 1980s led to a dramatic shift in emphasis from projects to policies.^{4/} This shift was associated with the recognition of two factors. It is virtually impossible to have good projects in a bad policy environment which reduces real returns to projects significantly. In addition, for countries with distortionary policies inimical to growth, there can be a high rate of return for policy reform. The emphasis on policy reform in developing countries received a further boost from the external shocks that buffeted many of them in the early 1980s and led to

^{1/} UNIDO, *Guidelines for Project Evaluation* (New York: United Nations, 1972); and I.M.D. Little and J.A. Mirrlees, *Project Appraisal and Planning For Developing Countries* (London: Heinemann, 1974).

^{2/} An excellent survey is given in L. Squire, "Project Evaluation In Theory and Practice", *Handbook of Development Economics*, vol. II, ed. H. Chenery and T.N. Srinivasan (B. V.: Elsevier Science Publishers, 1989).

^{3/} A.K. Sen, "Control Areas and Accounting Prices: An Approach to Economic Evaluation", *Economic Journal*, vol. 82 (1972).

^{4/} A.O. Krueger, "The Role of Multilateral Lending Institutions in the Development Process", *Asian Development Review*, vol. 7, no. 1 (1989).

cut backs in investment. The conventional wisdom that emerged was that after or accompanying a decline in investment, steps must be taken to improve the productivity of capital in the economy as a whole. This was to be achieved through improved efficiency by rationalizing government policy whereby distortions were reduced or removed leading to resource allocation into sectors enjoying comparative advantage and improving capacity utilization by alleviating supply constraints. An improvement in the productivity of capital would mitigate the adverse impact of the lower volume of investment on economic growth.

4. The fundamental change that occurred in many developing countries in the 1980s and that is likely to continue into the 1990s is that policy reform will be undertaken on a wide front. Therefore, the *ceteris paribus* assumption that existing policy distortions would continue into the future and which was widely used in the project evaluation literature will no longer be valid. The relationship between policy reforms and shadow prices needs to be explicitly considered. The main purpose of the paper is to examine some of the salient features of the interrelationship between shadow prices, project investment and policy reforms with a view to highlight issues for public choice between project investment and policy reforms. The interrelationship between shadow prices and policy reforms will demonstrate that the choice of projects and the choice of policies can, and should be examined within the same analytical framework. Examining projects and policies within the same framework leads to greater clarity and better understanding of some major aspects of public choice.

5. The paper begins with a broad overview of shadow prices emphasizing their close relationship with the policy environment. This is followed by the description of an analytical framework which integrates shadow prices and policies. The analytical framework is then used to highlight some of the major project evaluation shadow pricing rules. The interrelationship between project investment and public policy reforms emerges from this discussion. The paper ends with a description of some major research issues that need to be considered in assessing public choice between project investment and policy reforms. This agenda for research will help in determining whether the approach described in the paper can be operationalized in terms of quantification and measurement. While the main thrust of the paper is on the analytical aspects, a brief review of actual practice provides the interface with the analytics in indicating the research agenda.

II. SHADOW PRICES AND POLICY ENVIRONMENT: AN OVERVIEW

6. The shadow prices that are used in the economic analysis of projects are designed to provide a partial correction for the distortions that are caused by market failure. Market failure can be natural or artificial. Under certain conditions, free markets will automatically lead to the achievement of economic efficiency. When markets depart from these conditions in the absence of government intervention, natural market failure is said to exist. Natural market failure can be caused by monopolistic elements, external economies, public goods and paradoxes and

fallacies. Natural market failure provides the rationale for two sets of roles of governments: (i) macroeconomic interventions designed to augment growth rates, stabilize prices and ensure external balance; and (ii) sector and market-level interventions designed to correct for specific market failures. Artificial market failure is defined as (i) policy interventions which are designed to correct natural market failure but which are either inappropriate, insufficient or excessive; or (ii) policy interventions which disrupt an otherwise efficiently functioning market. Assuming that governments intervene to address issues raised by natural market failure, then the further need to use shadow prices could be looked upon as a criticism of the government for failing to intervene appropriately in the economy. Furthermore, in all cases involving the use of shadow prices, it could be argued that a more desirable alternative could be to design an optimal intervention to correct for the underlying market failure that led to the need for the use of a shadow price in the first place. Since optimal interventions are often not possible, the need for the use of shadow prices which depend on the policy environment remains. Thus, the crucial link between projects and policies will be the shadow prices.

7. Shadow prices are defined as the ultimate effect on society's welfare resulting from a change in the net supply of an input or output. Policy changes through influencing the availability of an input or output will also have an effect on society's welfare. Though conceptually different, both shadow prices and policy changes will need to be analyzed from the same welfare theoretical viewpoint. The need for this arises from the fact that the use of shadow prices and the recommendations for policy reforms are premised on the same consideration, namely, an improvement in resource allocation which is welfare improving. The tools of economic analysis that could be used in this context include both partial and general equilibrium approaches.

8. Much of the early literature on project evaluation was based on the partial equilibrium approach. Certain rules of thumb which were logical conclusions derived from a set of analytical frameworks evolved for shadow pricing. Neglecting induced price changes in a partial equilibrium framework, shadow prices equal border prices for tradeables and consumer prices for all other commodities and factors in the UNIDO Guidelines. Little and Mirrlees used costs, themselves measured at shadow prices, for deriving the shadow prices for non-traded inputs. The shadow price of labor was its marginal product at border prices. In the context of the partial equilibrium framework, these rules of thumb have stood the test of time and have been found to be analytically and empirically robust.^{5/}

9. Taxation, artificial market failure and shadow prices are closely related. Hence, the literature on taxation is relevant. The welfare theoretic literature on taxation evolved in both the partial and

^{5/} Squire, *op.cit.*

general equilibrium frameworks.^{9/} The partial equilibrium analysis was conducted in terms of demand and supply functions in a commodity market with distortionary taxes driving a wedge between demand and supply prices. The welfare cost implications of distortionary taxation were analyzed in terms of consumer and producer surpluses. When the analysis of the impact of a distortion in one market was extended to other markets, a general equilibrium approach became necessary. Consequently, the change in welfare following a policy change should be measured by the sum of all induced changes multiplied by the degree of distortion (tax or subsidy) in each market.^{7/} This is the Harberger measure of welfare change associated with policy reform. The literature on tax policy evolved in a closed economy framework. Given the close relationship between shadow prices and price distortions, shadow pricing rules in a closed economy general equilibrium model with distortionary taxes inevitably evolved.^{8/}

10. Shadow pricing rules in general equilibrium open economy models with trade distortions were also derived.^{9/} In these open economy models only trade distortions were considered. Welfare changes associated with trade distortions were measured by changes in tariff revenue which captured the general equilibrium consumption and production losses. Shadow pricing rules in an open economy general equilibrium framework with both taxes and tariffs were likewise derived.^{10/}

11. Much of the literature on partial and general equilibrium analysis of taxes and tariffs was based on the assumption of the availability of lump-sum transfers to ensure fiscal balance. By definition, the lump-sum transfers are non-distortionary because they do not introduce a wedge between demand price and supply price. The question that comes up is that if lump-sum transfers are available, why are distortionary trade, production and consumption taxes introduced? Lump-

^{9/} A.C. Harberger, "Three Basic Postulates for Applied Welfare Economics: An Interpretive Essay", *Journal of Economic Literature*, vol. 9 (1971).

^{7/} Harberger, *op.cit.*, provides the following measure of welfare change (dw)

$$dw = \int_{z=0}^{z^*} \sum_i D_i(z) \frac{\partial X_i}{\partial z} dz$$

Where D_i , the distortion, represents the excess of marginal social benefit over marginal social cost per unit level of activity i , X_i represents the number of units of activity i and z is the policy variable, the effects of whose change is being measured.

^{8/} R.W. Boadway, "Cost-Benefit Rules in General Equilibrium", *Review of Economic Studies*, vol. 42 (1975).

^{9/} T. Bertrand, "Shadow Pricing in Distorted Economies", *American Economic Review*, vol. 69 (1979).

^{10/} E. Sieper, "The Structure of General Equilibrium Shadow Pricing Rules for a Tax Distorted Economy" (Department of Economics, Australian National University, 1981).

sum taxes are not feasible in practice and governments frequently raise revenues through distortionary taxation. It is the existence of these distortionary taxes that leads to the need for shadow prices. Thus, the assumption of the existence of lump-sum transfers leads to a major problem of internal consistency in terms of establishing the need for the use of shadow prices. If fiscal balance has to be maintained through distortionary taxes, then their welfare costs need to be incorporated in the analysis.^{11/}

12. The above implies that if shadow prices are to be good measures of the net impact on social welfare of a unit increase in the supply of a good, then some of the general equilibrium implications will need to be incorporated in the analysis. The Harberger measure of revenue changes and the distortionary cost of maintaining fiscal balance when lump-sum taxes are not available will need to be introduced in the shadow pricing rules. The question that immediately comes up is that if general equilibrium considerations have to be routinely incorporated in shadow pricing rules, then shadow pricing for project evaluation will no longer be operational. While there is considerable merit in this argument, it is also true that ignoring certain distortions may bias the shadow pricing rules to such an extent that positive profits at shadow prices may no longer be welfare improving. A *via media* needs to be found between partial and general equilibrium approaches such that the more important effects are incorporated in the design of the shadow pricing rules.

13. In the context of finding this *via-media*, Harberger's measure of welfare change provides some useful insights. The set of activities with significant distortions is a subset of all activities. The set of activities whose levels are significantly affected by the action under study (project and/or policy reform) is another subset of all activities. Only the intersection is important for the analysis of the effects of the action in question. For example, those situations will need to be identified where the product of the difference between a shadow price and a market price and the size of an input or output is significant. The difference between a shadow price and a market price represents the extent of distortions and the input or output represents the impact of the project or policy reform. If the number of elements affected are of a manageable size, the Harberger approach can be operationalized.

14. This brief discussion on shadow prices and policy environment raises a number of important issues. First, the partial equilibrium shadow prices, in some cases, may need to be extended to incorporate the more important general equilibrium implications. The fiscal effect of a project warrants careful consideration. Second, when lump-sum transfers are not possible, the welfare effects of using distortionary taxes to maintain the fiscal balance must be incorporated in the shadow prices. In light of the above, public utility pricing policy and project evaluation are inseparable. Third, given rising budgetary deficits in many developing countries and the constraints on public sector investible resources, the integration of shadow pricing with policy reforms is both necessary and highly relevant.

^{11/} Squire, *op.cit.*

15. There is a need to derive a set of shadow pricing rules in a framework that incorporates traded and non-traded goods, primary factors, tax and tariff distortions, no lump-sum transfers and the existence of both private sector consumption and production as well as public sector production. This framework would necessarily be general equilibrium in approach. While the resulting complexity is a disadvantage, the advantage would be in the integration of shadow pricing rules and policy reform. Shadow pricing rules depend on existing policies and hence, the choice of projects and the choice of policies should be examined within the same framework.^{12/}

III. ANALYTICAL FRAMEWORK FOR INTEGRATING SHADOW PRICES AND POLICIES

16. For analytical convenience, a project is defined as a change in the net supplies of commodities from the public sector and a small project is represented by an "infinitesimal perturbation" of the public production plan.^{13/} The purpose of project evaluation is to ensure that public sector resources are allocated in a manner that will improve social welfare. The shadow price of a good measures the net impact on social welfare of a unit increase in the supply of that good by the public sector. Therefore, a project that shows a profit at these shadow prices will make a positive contribution to society's welfare. A project must be evaluated in terms of its consequences and hence it is important to have an analytical framework which would estimate the total effect on the state of the economy of undertaking a particular project. The total effect would involve a comparison of the economy with the project and the economy without it. The policy environment prevailing in the economy would have a significant impact on the total effect of a project. The shadow prices used in project evaluation cannot be properly defined without specifying a policy framework. Shadow pricing rules depend on existing policies. Therefore, the choice of projects and the choice of policies should be examined within the same analytical framework. Given the need to predict the total effect of a project and the importance of assessing the resource allocation impact of policy changes, the analytical framework would necessarily be a general equilibrium approach.

^{12/} J. Drèze and N. Stern, "The Theory of Cost-Benefit Analysis", *Handbook of Public Economics*, ed. A. Auerback and M. Feldstein (North Holland: Amsterdam, 1987).

^{13/} Drèze and Stern, *op.cit.* There are two reasons for this. First, the emphasis is on the public sector. Second, the evaluation of non-marginal projects requires information on pre-project and post-project equilibrium prices. The estimation of post-project prices is extremely difficult. See R. Harris, "On the Choice of Large Projects", *Canadian Journal of Economics*, vol. XI, 1978.

17. A small tax-distorted open economy is considered.^{14/} It has elements of both closed and open economy models and includes private consumption and production, public production and international trade. The small country assumption implies that international prices are given. A representative consumer maximizes utility subject to a budget constraint. The assumption of a single consumer is made to ignore considerations of income distribution. The private and the public sectors are the two sources of domestic supply. The private sector takes producer prices as given and determines supplies that will maximize profits. With constant returns to scale, private profits are zero at equilibrium. The public sector supplies commodities and demands factors, and a project is defined as a change in the net supplies of commodities from the public sector.

18. In addition to public production, the government influences prices by imposing taxes and tariffs and providing subsidies. These interventions drive a wedge between demand and supply prices and are distortionary in nature. Lump-sum taxes are defined as instruments which do not drive such a wedge. Government revenue from distortionary taxation and public sector profits can be used for lump-sum transfers or for achieving targets established for budgetary surpluses but not both. Policy reforms in this paper will only relate to pricing measures that influence market distortions through reducing the wedge between demand and supply price.

^{14/} Squire, *op. cit.* provides the model described below.

$$\text{Max } U = U(c) \quad (1)$$

Subject to:

$$\text{Private Sector Budget Constraint } qc = qc + py + L \quad (2)$$

$$\text{Government Budget Constraint } Z = R + px - L \quad (3)$$

$$\text{Government Revenue Constraint } R = tc - s(y+x) \quad (4)$$

$$\text{Market Clearing } c = y + x + e + m \quad (5)$$

Notation:

U	=	individual utility function
q	=	vector of consumer prices
p	=	vector of producer prices
c	=	vector of private sector consumption
e	=	vector of initial endowment of primary factors
x	=	vector of net output from the public sector
y	=	vector of net output from private sector
L	=	lump-sum transfers
Z	=	government's budget surplus
R	=	government's net revenue
t	=	vector of net taxes on consumption of tradeables
s	=	vector of net subsidies to consumers
r	=	vector of border prices

- Note: 1. Consumer price for tradeables $q = r + t$
 Producer price for tradeables $p = r + s$
 Prices for non-tradeables and primary factors $q = p - s$
 2. For tradeables $e = 0$
 For non-tradeables $m = e = 0$
 For primary factors $x = m = 0$

In this system, if the government budget is balanced ($Z=0$) and 2 and 5 hold, then the economy's transactions with the rest of the world will be in balance, i.e., $rm = 0$. This implies that it is not necessary to consider both the government budget constraint and the balance-of-payment constraint. Given the thrust of the paper only the government budget constraint is considered.

Defining the change in welfare $dw = dU/\lambda$ where λ is the marginal utility of income and using constraints 2, 3 and 5, the following can be derived:

$$dw = -dZ + (dR + p dx) \quad (6).$$

19. Equilibrium in this economy is specified by market clearing for non-tradeables and primary factors through price adjustments. The markets for tradeables clear by means of changes in net imports. This equilibrium assumes a given level of public production and tariffs and subsidies. It should be noted that public sector production is assumed to be exogenous. Starting off from an equilibrium position, the question is how can welfare be improved? At full equilibrium welfare will be determined by the exogenous variables in the system - factor endowments, border prices for tradeables and the government's policy instruments which will include public sector production (x), and desired budget surplus (Z). Assuming factor endowments and border prices are fixed, welfare at equilibrium can be expressed as depending on public sector production (x) and the desired budget surplus (Z) which become the control variables. The desired budget surplus, in turn, will be influenced by the imposition of taxes (t) and subsidies (s) which are the policy parameters. In that sense Z is the proxy for policy change. Defining an "infinitesimal perturbation" as a small variation in the pattern of public production and desired budget surplus, a comparative static exercise can be undertaken to solve for the new general equilibrium of the economy. The new quantities and prices are determined such that all markets clear and the budget constraints for both the private and public sector are met. The change in welfare can now be summarized by the following expression:

$$[\text{Change in welfare}] = - [\text{Impact of Policy Change}] + [\text{Impact of Project}]^{15/}$$

20. This general expression is useful in unifying the assessment of a change in welfare resulting from an arbitrary project combined with a policy reform. First, the impact of a project can be analyzed. Second, the impact of a policy change in the absence of a project can also be analyzed.^{16/} The change in policy can be brought about by a change in tariffs or taxes and subsidies which become the policy parameters. This discussion will show that the change in welfare will be influenced by the interaction between policy changes and projects.

21. Ignoring policy changes, a change in welfare can be brought about by the introduction of a small project. The shadow prices are given by the sum of the producer prices and a measure of the change in tax and tariff revenue brought about by the inputs and outputs associated with the project.^{17/} The latter represents the sum of all induced changes multiplied by the degree of distortion (tariff or subsidy) in each market.^{18/} The change in tax and tariff revenue captures the production and consumption losses occurring in other markets as a result of the project. It should be noted that only if lump-sum transfers exist can policy changes

$$^{15/} \quad dw = - dZ + (\partial R/\partial x + p) dx \quad (6)$$

^{16/} The expression $-(dw/dZ)$ is the marginal social cost of increasing the budget surplus.

^{17/} The shadow prices are given by $(\partial R/\partial x + p)$ with the effects of existing distortions being captured by $\partial R/\partial x$.

^{18/} Harberger, *op.cit.*

associated with the need to balance the government budget arising from project induced changes be ignored.

22. If lump-sum transfers do not exist, then distortionary taxes will need to be introduced to balance the government budget. It should be noted that this balancing is solely related to the project's impact on the government budget. Lump-sum taxes are not available to meet the deficit caused by the project. Now the marginal social cost of increasing the budget surplus would have to be included in estimating the shadow price.^{19/} Such a shadow price explicitly incorporates the general equilibrium implications of the effects of the existing policy environment on tax and tariff revenue and the effects of policy changes which are distortionary in nature and are necessitated by the project in balancing the government budget. Since the total effect of a project on the economy has to be incorporated in the economic analysis and the introduction of the project results in additional distortionary taxes which have welfare costs, these would have to be included as a part of the total effect of a project. This is the rationale for incorporating the additional welfare costs of distortionary taxes which result from the project in the shadow pricing rule.

23. In this framework, border prices remain the appropriate shadow prices for tradeable commodities. The relative shadow prices for non-tradeables and factors depend on producer prices and marginal product, tax revenue changes caused by existing distortions in all markets and the method used in closing the budget. The third term disappears when lump-sum transfers are available.^{20/} The advantage of following a two-stage procedure of first assuming the existence of lump-sum transfers to meet budgetary deficits caused by the project and then dropping it is to clearly indicate the impact of the latter on the shadow pricing rule.

24. The shadow pricing rule for non-tradeables and factors differ from the partial equilibrium shadow prices recommended by Little and Mirrlees in two significant ways. First, the inclusion of change in tax

^{19/} This will be given by $[-\partial Z/\partial x + \partial R/\partial x + p]$. It should be noted that the inclusion of $-\partial Z/\partial x$ incorporates the effect of a policy change accompanying a project on the shadow price.

^{20/} Using the general framework given in equation (6), the following shadow pricing rules can be derived

$$\begin{aligned}\pi_k &= r_k && \text{for tradeables} && (7) \\ \pi_k &= p_k + \partial R/\partial x_k + \alpha \sum_i \partial p_i/\partial x_k && \text{for non-tradeables} && (8)\end{aligned}$$

Where π_k is the shadow price of good (factor) k , α is the excess of the marginal welfare cost of raising lump-sum revenue over the marginal welfare cost of raising revenue through distortionary taxation and $\partial p_i/\partial x_k$ is the change in producer prices of non-tradeables caused by a unit increase in x_k . The third term in (8) is associated with $-\partial Z/\partial x$ in footnote 19. It represents the additional welfare costs resulting from the imposition of new distortionary taxes necessitated by the project.

and tariff revenue incorporates the consumption and production losses and gains emanating from the total impact of a project. Second, the third term explicitly accounts for the equilibrating mechanism used by the government in the absence of lump-sum transfers. The factor captured by the third term is aptly summarized in the following statement:

"For purposes of social cost-benefit analysis, a project may be viewed as a disturbance to the economy, displacing it from some initial equilibrium to a new one. But the new configuration will depend on which particular variables adjust to restore equilibrium. Since there may be more than one admissible form of adjustment, it is natural to ask how - if at all - the corresponding shadow prices for project evaluation depend on the nature of adjustment. Now, the manner in which the economy equilibrates depends on how the government responds to the disturbance that the project generates."^{21/}

Different policies correspond to different rules for shadow pricing. Given that the government budget has emerged as one of the most important constraints in many developing countries, the significance of the equilibrating mechanism in determining the shadow prices cannot be overemphasized.

25. Having described the close relationship between shadow prices and the policy environment, it is useful to again consider the link between welfare change, policy change and project investment. It should be noted that in the kind of comparative static exercise envisaged, the project cum-policy reform is arbitrary and not optimal. Starting from an arbitrary initial environment, the analytical framework described can be used to examine desirable policy (tax or tariff) reforms which will lead to an improvement in social welfare. The emphasis is on determining desirable directions of change when piecemeal or phased policy reforms are being attempted.^{22/} A welfare improvement is possible even without a project since policy changes alone can be welfare improving. Alternatively, a project which is not viable by itself can become highly viable if it is combined with a suitable change in policy. This could happen because the shadow prices may change as the result of a policy change.

26. Policies and projects may have to be considered as a package. Welfare improvements associated with policy changes hinge on resource reallocation which under certain circumstances could be facilitated by projects. The higher are the supply elasticities brought about by the projects, the greater would be the welfare improvements associated with

^{21/} C. Bell and S. Devarajan, "Shadow Prices for Project Evaluation Under Alternative Macroeconomic Specifications", *Quarterly Journal of Economics*, vol. 97, 1983.

^{22/} D.M.G. Newbery and N.H. Stern, *The Theory of Taxation for Developing Countries* (Washington, D.C.: The World Bank and Oxford University Press, 1987).

a policy change. Supply elasticities and project investment could be highly correlated. On the other hand, a desirable policy change will lead to a decline in the distortionary cost of taxation increasing the shadow price of the good and thereby improving the economic viability of that activity or project.^{23/}

IV. PROJECTS, SHADOW PRICES AND POLICIES: SOME STYLIZED CASES

27. While the generalized framework described in the previous section is useful in terms of providing a broad perspective against which policies and projects can be analyzed, a consideration of some stylized situations will indicate the applicability of the approach and will also provide additional insights. The literature on project evaluation in developed countries has frequently been concerned with the evaluation of traditional public sector projects like roads, irrigation and water supply. In developing countries, the public sector is often engaged in direct production as well. Therefore, in this section, three types of public sector projects are considered: (i) an industrial project which has a large tradeable component; (ii) an infrastructure project where costs are borne by the public sector but benefits accrue to the private sector; and (iii) a public utility project which supplies a non-tradeable service like electricity.^{24/}

28. The rationale for the choice of this three-fold classification is based on two considerations. First, the tradeable versus non-tradeable distinction is extremely important in shadow pricing rules. As already indicated, border prices are the appropriate shadow prices for tradeable commodities. Since the small country assumption ensures that border prices remain constant, adjustment through tradeables only implies that there will be no induced price changes. Second, the existence of private sector consumption from public sector output in non-tradeables raises important issues in the identification, quantification and valuation of project benefits. In terms of valuation, if lump-sum transfers are not available then the distortionary costs of raising revenue will have a bearing on shadow pricing rules.

29. An industrial project which has a large tradeable component in terms of both inputs and outputs will be relatively easy to analyze. All production will be within the public sector and border pricing of the main inputs and outputs will be straightforward. Interaction with the private sector will consist mainly of factor and non-tradeable input purchases. In this situation, the tradeable components of the project will dominate and minor changes in the shadow prices of non-tradeables due to changes in the distortionary costs of taxation will not influence appraisal. Furthermore, the exclusion of indirect effects on revenue and adjustments for alternative means of raising revenue will not be important in

^{23/} A decline in α in equation (8) will increase the shadow price of x_k if $\sum_i \partial p_i / \partial x_k$ is negative.

^{24/} Squire, *op. cit.*

determining the economic viability of such a project. The shadow prices derived from a partial equilibrium framework are likely to be adequate in determining welfare improving industrial projects with a large tradeable component.^{29/}

30. An important consideration in an industrial project is the difference between financial and economic profitability. If an important intermediate input is protected, the project could be economically viable but financially unprofitable. In this situation, a policy reform to reduce protection on the intermediate input would warrant consideration. Otherwise, the subsidy payments to ensure financial viability would need to be explicitly taken into account in terms of distortionary costs of raising revenue to pay for the subsidies. This would raise the economic cost of the protected non-traded intermediate input making the project economically non-viable.

31. An industrial project could also be financially viable but economically non-viable. Policy reforms which would transform some non-tradeables into tradeables could make the project economically viable. The point to note here is that the policy change would directly affect the shadow prices of inputs thereby possibly changing the least-cost solution and raising economic profitability of the project. While industrial projects with a significant tradeable components are straightforward to analyze, the role of the policy environment in determining the economic and financial viability will be important. Therefore, a project cum-policy reform approach could be necessary.

32. The characteristic of an infrastructural project like a road, irrigation or health facility is that costs are borne by the public sector but benefits accrue directly to the private sector. A transfer occurs from the public to the private sector through the provision of infrastructure services at zero cost. Such transfers or subsidies could be very large in absolute terms and could also be large relative to the net benefits from such a project. This feature of infrastructural projects which provide large transfers of income to the private sector implies that the adjustment factor related to the method of revenue generation could be important.^{29/} The welfare costs of generating revenue

^{29/} This is precisely what was demonstrated in I.M.D. Little and J.A. Mirrlees, *Manual of Industrial Analysis in Developing Countries, II, Social Cost-Benefit Analysis* (Paris: OECD, 1969).

^{29/} A general shadow pricing rule related to equation (8) can be derived as follows:

$$\pi_k = p_k + \partial R / \partial x_k + \alpha \sum x_i \partial p_i / \partial x_k - \alpha (p \partial y / \partial x_k - \hat{p}_k) \quad (9)$$

Where $p \partial y / \partial x_k$ is the increase in private sector income following the improvement in infrastructure and \hat{p}_k is the fixed charge for the service provided by the project. The fourth term in brackets on the right hand side of (9) represents the extent of subsidy provided per unit of service and the fourth term indicates the welfare costs of generating revenue to pay for the subsidy.

to pay for the subsidy would have to be incorporated in the shadow pricing rules.

33. Consider the following simple case. Assume that the infrastructural project leads to an increase in private sector net output which consists of tradeable goods only.^{27/} The shadow price of the public sector infrastructure project under consideration will equal the value of induced private sector output at border prices less the cost of paying for the subsidy. The exclusion of the latter terms will lead to an overestimation of the shadow price of the infrastructural output produced by the project.

34. In case the private sector net output consists of non-tradeables, the prices of non-tradeables and primary factors will change and the derivation of the shadow price of the infrastructural output will be complex. If producer price is used to determine shadow prices, as would be implied by the partial equilibrium approach, infrastructural shadow prices are likely to be upwardly biased. Given the importance of the government's budgetary constraint, the inclusion of the marginal welfare cost of raising revenue through distortionary taxation in the shadow pricing of infrastructural output would be a step in the right direction.

35. Policy reforms could take two forms. First, an overall policy reform of the tax system is likely to reduce the welfare costs of distortionary taxation.^{28/} A reduction in the welfare costs of distortionary taxation will, *ceteris paribus*, increase the shadow price and thereby improve the economic viability. Therefore, with policy reform more infrastructure projects will become economically viable. Second, a tariff reform could reduce the extent of subsidy. This case is considered below.

36. Lastly, non-tradeable public utility projects producing services like electricity are considered. Prices or tariffs are set by governments at levels below which they are required to clear the markets. The failure to clear markets by tariff adjustments leads to a transfer of income to the private sector. Distortionary pricing applies to the project's entire output. As in the case of infrastructural projects, the costs are generally borne by the public sector while most of the benefits accrue to

^{27/} This implies that there will be no induced price changes ($\partial p_i / \partial x_k = 0$). Assume $\hat{p}_k = 0$ and there are no other distortions or $\partial R / \partial x_k = 0$. Now the shadow price is given by

$$\pi_k = r \partial y / \partial x_k - \alpha p \partial y / \partial x_k \quad (10)$$

Where dy is tradeable net output

^{28/} A policy reform will reduce α in equation (10).

the private sector.^{29/} The welfare costs of generating revenue to pay for the subsidy would have to be incorporated in the shadow pricing rules.

37. If these welfare costs are ignored, the shadow price will be overestimated.^{30/} This result clearly indicates that public utility pricing policy and project appraisal results become inseparable. The impact of policy reform on shadow prices can be seen at two levels. First, a general policy reform on tax and tariff policy will reduce the welfare costs of distortionary taxation.^{31/} *Ceteris paribus* this will increase the shadow price. Second, a reduction in electricity subsidy will increase the shadow price.^{32/} Both reforms will therefore increase the economic profitability of the project.^{33/}

38. An alternative way of examining the issues raised by the distortionary cost of raising revenue to pay for the subsidy is to consider a simple example. If subsidy on a project is 60 per cent of total costs and the marginal social cost of tax financing is 0.80 of revenue generated, this implies that additional costs equal to 48 per cent of total project costs are being incurred. The shadow pricing rules described incorporate this aspect.

^{29/} Equation (9) provides a general framework for shadow pricing. Making the same assumptions as were used to derive equation (10) except assuming that electricity is priced at \hat{p}_k , the following shadow pricing rule emerges

$$\pi_k = r \partial y / \partial x_k - \alpha (p \partial y / \partial x_k - \hat{p}_k) \quad (11)$$

^{30/} By ignoring the second term in equation (11) where $\alpha > 0$ and $(p \partial y / \partial x_k - \hat{p}_k) > 0$ because a subsidy is being given, the shadow price of electricity will be overestimated.

^{31/} α is reduced in equation (11).

^{32/} A reduction in subsidy will reduce $(p \partial y / \partial x_k - \hat{p}_k)$ in equation (11).

^{33/} In practice, the shadow pricing of a public utility service like electricity can be described as following two approaches. First, the market price or tariff (\hat{p}_k) is adjusted by a conversion factor (CF) which should be $(r \partial y / \partial x_k) / (p \partial y / \partial x_k)$. There are two errors introduced - exclusion of the second term in equation (11) and mis-specification of the first term as the conversion factor should be applied to private sector net output at market prices and not the tariff paid for the output of the public utility. The sign of the net error introduced by this practice is given by $(CF - \alpha)$. If this term is positive, net benefits are underestimated. Second, the shadow pricing is based on the first term in equation (11). The exclusion of the second term introduces an upward bias to the shadow price of electricity. The second approach is increasingly being used in the shadow pricing of public utility pricing, thereby upwardly biasing the project's economic profitability.

39. While the discussion on shadow pricing for infrastructural and public utility pricing indicated that in general, the interactions were far too complex to arrive at clear-cut solutions, in the stylized cases the nature of bias involved by using a modified partial equilibrium approach can be gauged. Two types of reforms were considered. First, the impact of a decrease in the welfare cost of distortionary taxation arising out of an overall tax reform was examined. Second, the effect of a change in public utility pricing policy for a subsector like power was assessed. The neglect of the welfare cost of distortionary taxation in cases where the public utility is giving significant subsidies to the private sector, could lead to a systematic overestimation of net benefits. Therefore, introducing policy reforms which reduce the welfare cost of distortionary taxation will increase the economic profitability of certain infrastructural and public utility projects.

40. In addition, the policy reform could also take the form of calculating the long-run marginal cost of electricity at shadow prices and then designing an appropriate tariff system. This would imply that transfer to the private sector or subsidy would approach zero, thereby eliminating the problem that led to the overestimation of benefits. An important issue that comes up in this context is the ability of the project evaluator to secure policy changes.^{34/} However, multilateral development banks may be able to encourage such changes through their project lending.

41. The approach to shadow pricing that has been described is premised on the need to examine the choice of projects and the choice of policies within the same analytical framework.^{35/} The need to assess the total effect of a project and the importance of the policy environment in influencing resource allocation make it inevitable that the more important general equilibrium effects should be taken into account in designing shadow pricing rules. The approach described does just that. Furthermore, by highlighting the need to take account of the welfare costs of distortionary taxation in the shadow pricing rules two aspects are highlighted. First, the fiscal effects of projects should be analyzed including the more important indirect effects.^{36/} Second, public utility pricing policy and project appraisal results become inseparable.

42. It has been indicated that the literature on project evaluation in developed countries was concerned with traditional public sector projects like infrastructure and public utilities while in developing countries, the scope was extended to direct production like industry and agriculture. In the 1990s, public intervention in developing countries

^{34/} Sen, *op.cit.*

^{35/} The description of the analytical framework given in footnote 14 and the derivation of the change in welfare in equation (6) clearly establishes this.

^{36/} I. Ali, *Foreign Exchange and Fiscal Impact of a Project: A Methodological Framework for Estimation*, EDRC Report Series no. 49 (Asian Development Bank, February 1990).

is likely to be more focussed with issues linked to the policy environment occupying center stage for agriculture and industry, while public investment will be directed at the traditional infrastructure and public utility sectors. The issues raised in this section indicate that economic viability for these projects will depend on taking a project-cum-policy reform approach.

43. The purpose of project evaluation is to provide a consistent procedure for assessing investment decisions in terms of their consequences. Selection of projects is based on profitability at shadow prices. The analytical framework described in this paper indicates that a project that shows a profit at these shadow prices will improve social welfare. This framework is also useful in designing piecemeal or phased policy reform. Starting from an initial equilibrium, a set of desirable policy changes or reforms which are welfare improving can be determined. The reforms can be judged to be desirable only after analyzing and estimating the total effect of the proposed reform on the economy.

44. The total effect will be in terms of resource allocation which will lead to changes in production, consumption and foreign trade. The welfare change is often measured in terms of revenue changes incorporating both direct and indirect effects.^{37/} The total effect will be measured in terms of the state of the economy with and without the policy change. While the general equilibrium implications of a policy change will need to be considered, the problems of measurement need not be insuperable. Only the most important general equilibrium effects are relevant for assessing welfare change associated with a project-cum-policy change for which a full scale general equilibrium approach may not be necessary.

45. In principle there is no difference in analyzing the impact of a project and the impact of a policy change. This is perhaps the most important lesson that has come out from the recent literature on cost-benefit analysis and which has been discussed in this paper.^{38/} The analytical framework described indicates the need to incorporate both direct and indirect effects. In the case of a project, these will be captured by the decomposition recommended by Little and Mirrlees in their semi-input-output method. In the case of a policy change, these will have to be captured through the use of input-output tables focusing on the more important aspects as implied by the Harberger approach. In terms of the practical problems of identifying, quantifying and valuing costs and benefits, the issues for analyzing and assessing infrastructural projects and policy changes are identical. The methods may differ but the approaches will need to capture the direct and indirect effects. The common characteristics shared by both infrastructural projects and policy reforms is that while costs are borne by the public sector, the widely dispersed benefits accrue to the private sector. Therefore, if in principle, rates of returns can be calculated for infrastructural

^{37/} Harberger, *op.cit.*, T.J. Bertrand and J. Vanek, "The Theory of Tariffs, Taxes and Subsidies: Some Aspects of Second Best", *American Economic Review* (December 1971).

^{38/} Drèze and Stern, *op.cit.*

projects, they can also be calculated for policy reform defined as reducing the wedge between demand and supply price.^{39/}

46. At a practical level, project evaluation for many sectors is undertaken using various short cuts. There is no reason why similar rough and ready methods should not be undertaken in the case of assessing policy change. The issues raised in this section provide a benchmark against which the biases introduced by using practical approaches can be analyzed. It is not being suggested that practical approaches be dispensed with but rather how they can be improved in certain specific instances. Similarly, the framework of analysis described provides some insights on how policy changes can be assessed starting from a partial equilibrium approach and introducing the more important indirect effects.

V. SHADOW PRICES IN PRACTICE

47. The analytical discussion of shadow prices in this paper can be separated into three distinct categories. First, simple shadow pricing rules can be derived through the use of partial equilibrium techniques. Second, rules are derived such that the direct and indirect effects on the budget are incorporated to account for the general equilibrium repercussions of a project. Both these approaches are based on the existence of lump-sum taxes to meet budgetary deficits caused by a project. The third approach of devising shadow pricing rules explicitly accounts for the fact that lump-sum transfers may not be feasible in most developing countries. The shadow prices that emerge in this situation are the sum of shadow prices when transfers are feasible plus a term which accounts for the cost of adjusting the budget by distortionary taxation. Against this background, it would be useful to examine the use of shadow prices in practice.

48. In actual practice, the partial equilibrium approach has been applied.^{40/} With the adoption of the Little Mirrlees methodology for the economic analysis of projects, the use of specific, group and standard conversion factors was endorsed for valuing costs and benefits of non-traded items in border price equivalents or economic prices. In this paper, the terms shadow prices and conversion factors are used synonymously. This approach to investment analysis could have led to the use of three broad adjustments for valuing non-traded goods in border prices. First, the impact of domestic distortions arising from market imperfections, government intervention and market failure could have been

^{39/} R. Kanbur, "Projects versus Policy Reform" (Paper presented at the World Bank Annual Conference on Development Economics, Washington, D.C. [1990]). The paper illustrates how rates of return calculations can be made for assessing the impact of policy reforms in some special cases.

^{40/} An excellent description is given in I.M.D. Little and J.A. Mirrlees, "Project Appraisal and Planning Twenty Years On" (Paper presented at the World Bank Annual Conference on Development Economics, World Bank, Washington, D.C., April 1990).

removed from market price. In practice, only taxes and transfers were netted out from market prices to account for the impact of government intervention. Second, the impact of foreign trade distortions arising from government intervention like the imposition of tariffs and quotas on individual commodities could have been removed through disaggregation. In practice, a standard conversion factor has generally been applied across all non-traded goods and services regardless of their share in total costs and benefits.^{41/} Third, shadow wage rates were rarely estimated and used. Thus, in practice, partial rather than complete border pricing rules were used even in a partial equilibrium framework.

49. The most important improvement that took place in the 1970s was the greater use of border prices for tradeable goods. Apart from the cut-off discount rate, the only shadow price used was the shadow exchange rate or the standard conversion factor. Moreover, the methodology used to estimate the standard conversion factor was often not specified. The use of a single standard conversion factor implies that little attempt was made to estimate the actual foreign exchange consequences of using or producing non-traded goods. It is only in the case of public sector industrial projects with significant tradeable components and minor linkages with the private sector, would the inaccuracies of recouring to the use of a single standard conversion factor not be serious. In these projects the use of border prices account for the more significant distortions arising from protectionist policies. However, for non-traded goods, the use of a single standard conversion factor had little analytical or empirical justification.

50. In terms of empirical estimation of shadow prices of national parameters like shadow wage rate, accounting rate of interest, shadow exchange rate as well as sectoral shadow prices, significant work was undertaken by the World Bank, Inter-American Development Bank and some Universities in the 1970s. Input-output methods were used to estimate the shadow prices.^{42/} These efforts peaked in the early 1980s and interest in estimating shadow prices has waned since then. One implication of this is that even in the partial equilibrium context, shadow prices that are being currently used have a vintage of the early 1980s.

51. In terms of the framework described in this paper, a shadow price represents the marginal impact on social welfare of any quantity changes. Positive profits estimated at shadow prices lead to welfare improvements. Shadow prices are determined by the policy environment. The partial equilibrium shadow prices now available are irrelevant because they are outdated. The use of a single standard conversion factor could be justified for an industrial project with a large tradeable component. It is not justified for non-tradeable goods and services. The sobering

^{41/} I. Ali, *A Review of Economic Analysis of Power Projects in Asia and Identification of Areas of Improvement*, EDRC Report Series no. 45 (Asian Development Bank, November 1989) and A.M. Tadle, *Evaluation of Water Supply Projects: An Economic Framework*, EDRC Report Series no. 51 (Asian Development Bank, June 1990).

^{42/} Little and Mirrlees, 1990, *op.cit.*

conclusion that emerges is that the project evaluation techniques so assiduously developed in the late 1960s and early 1970s and adopted with so much fanfare were, in practice, seldom used. Even in the limited context of partial equilibrium shadow pricing rules, there is little justification for expecting that current practices using outdated shadow prices will lead to an improvement in resource allocation and hence in welfare.

52. Two issues need to be considered. First, there is the question why only a single conversion factor was used in practice. Two answers are possible. Disaggregated conversion factors were too difficult to estimate. In addition, the effort or cost of estimation was not worth the outcome or the benefit. Second, why did the estimation of shadow and conversion factors practically stop after 1981? In the 1980s, three factors stood out prominently: (i) there was a shift in emphasis from projects to policies; (ii) increased emphasis was given to social infrastructure projects; and (iii) poverty alleviation projects gained prominence. In these three areas, decisions were generally not based on explicit cost-benefit tests. Shadow prices and cost-benefit analysis are inseparable. With a decline in interest in cost-benefit analysis, a decline in the interest in shadow prices was inevitable. However, this is surprising for a number of reasons.

53. As has been indicated in this paper, shadow prices are fundamental to assessing the need for both policy changes as well as investment projects. It could be argued that policy changes which got prices right made it less crucial to have shadow prices. However, getting the prices right presupposes the knowledge of the shadow prices. In that sense, estimating the shadow prices and getting the prices right are different sides of the same coin. The assumption here is that getting rid of the effects of the distortionary factors is a major factor in getting the prices right.

54. It has been indicated that there may be difficulties in tracing the effects of infrastructure projects thereby making their project evaluation difficult. On account of this, the least-cost analysis of an infrastructure project becomes the most important element of the economic analysis. Admittedly, this is a necessary but not sufficient condition for project viability. The least-cost analysis must be undertaken in terms of shadow prices.

VI. PUBLIC CHOICE BETWEEN PROJECT INVESTMENT AND POLICY REFORMS

55. The issue of public choice between project investment and policy reform is usefully addressed in terms of the analytical framework described in this paper. To simplify the exposition, policy reform will be viewed as a means of reducing price distortions through narrowing the wedge between demand and supply price. Project investment is used for augmenting the supply of capital. While the objective of policy reform could be viewed as increasing efficiency through resource reallocation and thereby move to or along the frontier of a production possibility schedule, public investment could be viewed as moving the frontier itself.

A characteristic of project investment is the time lag between input and output streams. The time lag becomes an important factor in calculating rates of return. Can a similar analogy be drawn for policy reform so that rates of return can be estimated for resources allocated to facilitate policy reform?

56. Given its widespread impact, a policy reform could have major implications for the intra and intertemporal distribution of income. At a point of time there could be redistribution of income from one group to another. If the policy change is welfare improving, the gains of the winners will outweigh the losses of the losers. However, the constraints on taxing the winners to compensate the losers make it necessary for explicitly recognizing that a policy reform may require substantial budgetary outlays for alleviating the problems associated with this intratemporal redistribution of income as a result of the policy reform. In this example of intratemporal redistribution of income, constraints on taxing the winners imply expending real resources to compensate the losers. Thus, the adjustment cost is an economic cost and is not a transfer payment. In terms of the intertemporal redistribution of income, adjustment costs arising out of factor immobility could, in the short run, lead to declines in national or sectoral income. These declines would be followed by increases in national or sectoral income in later years. There could be a need to alleviate the costs of adjustment arising out of this intertemporal redistribution of income. There will also be cases where the problem of adjustment costs will be particularly severe because of both intra and intertemporal redistribution of income. In the case under consideration, redistribution of income is not the objective of the policy reform but is an outcome whose effects have to be dealt with on political economy considerations.

57. The adjustment costs associated with the intratemporal and intertemporal redistribution of income resulting from policy reform could be viewed as constituting the upfront costs associated with policy reform. Once this dimension is included, the adjustment costs which have to be alleviated through budgetary outlays could be viewed as the counterpart of investment in projects and the benefits from improved resource allocation resulting from the policy reform would be analogous to output from projects.⁴³ Budgetary outlays could be needed to alleviate adjustment costs to provide flexibility to an economy as it changes course from a set of bad to a set of better policies.

58. Having described the points of commonality between project investment and policy reforms, the question that has to be addressed is how should a policy package be assessed. The analytical framework described in this paper now becomes useful. The framework is particularly attractive when a policy maker inherits an initial environment which is not optimum but lacks the information necessary to locate the optimum. If a collection of parameters is specified, this information can be used to calculate the shadow prices and marginal social values associated with policy changes. Desirable directions of change associated with projects and policies can then be determined.

⁴³ Kanbur, *op. cit.*

59. Ignoring projects, the policy packages can be assessed in isolation. Whenever benefits in the form of increments in social welfare outweigh costs associated with the policy reform, the reform should be worth undertaking. While the above is analytically straightforward and obvious, assessing and establishing the need for policy reform has proved to be far more difficult in practice. Policy reforms are generally not assessed in terms of a comparison between costs and benefits. The argument put forward is that their benefits are widely dispersed over time and people. It is neither possible for the government to track down the widely dispersed benefits of a policy reform nor is it possible to make the beneficiaries pay for the cost of the package.^{44/} Thus, difficulties in identifying and quantifying benefits have led to qualitative rather than quantitative assessment of policy reforms. This state of affairs can lead to the conclusion that while project investment is subject to the discipline of project appraisal, no such discipline applies to assessing the case for policy reform.

60. But the need for quantitative assessment of policy reforms deserves consideration for a number of reasons. First, the purpose of both project and policy reforms is to improve social welfare and the analytical framework for assessing both is identical. Second, project investments are routinely subjected to quantitative assessment. Third, policy reforms and infrastructure projects have similar characteristics - the public sector bears the costs and the private sector enjoys the benefits. If infrastructure projects are subject to quantitative assessment, should not policy reform recommendations undergo the same analysis? Fourth, in identifying and quantifying costs and benefits in project evaluation, the with and without project situations have to be projected incorporating the more important general equilibrium effects of a project. Thus, qualitatively, there is no difference between a project and a policy reform in terms of estimating costs and benefits. Fifth, the question can be raised as to what are the costs of a policy reform. As has already been indicated, there could be intra and intertemporal redistribution of income resulting from policy reforms. These adjustment costs can be viewed as constituting the upfront costs of the reforms. The upfront costs are analogous to capital costs of a project. Sixth, in light of the above and assuming the identification and quantification of total benefits and costs are feasible, rate of return calculations should be possible for estimating the costs and benefits of policy reform.^{45/}

61. In terms of the analytical framework of this paper, developing countries should design their projects and policy packages with the one and same criterion - increased social welfare. The paper has shown that the economic viability of a project depends on the policy environment and an improvement in the latter could improve the former. The impact of policy reform on social welfare depends partly on supply response which in turn depends on supply elasticities that could be raised through

^{44/} World Bank, "Adjustment Lending: An Evaluation of Ten Years of Practice", *Policy and Research Series*, no. 1 (Washington, D.C., 1989).

^{45/} Kanbur, *op. cit.*

project investments. This could provide the rationale for hybrid approaches with both project investment and policy reform programs being considered in one project cum-policy reform package.^{46/} Optimally, the allocation of total resources of countries between projects and policy reforms should be based on where the marginal impact on social welfare is the greatest.

62. While this section on public choice between project investment and policy reforms makes a case for an integrated approach on analytical considerations, a number of factors need to be kept in mind. First, the analogy between projects and policies in terms of lagged input-output relationships is drawn on the assumption that the adjustment costs associated with policy reforms are the counterpart of investment flows in projects. Second, the policy reforms is defined in terms of reducing the wedge between demand and supply price. Third, on practical considerations, identification and quantification of benefits and costs in a policy reform package may raise difficulties as experienced in infrastructure projects. Fourth, estimating the welfare costs of distortionary taxation could pose problems. Thus, while on analytical considerations there is little difference in assessing project investments and policy reforms defined as narrowing the wedge between demand and supply price, a major research effort may need to be mounted for assessing the viability of operationalizing the framework described in this paper.

63. Given the public sector resource constraint facing many developing countries, the issue of optimal allocation of resources between projects and policy reforms takes on added importance. This paper is premised on the view that rigorous cost-benefit analysis should provide the underpinning for making the optimal allocation of public sector resources. The rationale for the analytical framework described and discussed stems from such a consideration. Practical approaches to implement an analytical framework which integrates projects and policy reforms will need to be developed and the research agenda described below indicates a starting point for initiating meaningful empirical work for implementing rigorous cost-benefit analysis for both projects and policies.

64. An important aspect of the research issues discussed is one of cost of the research and their practicality. The cost of not undertaking the research is equally relevant. Rigorous cost-benefit analysis will require resources without which only cosmetic analysis will be possible. In the absence of research which will enable rigorous cost-benefit analysis of both projects and policy reforms, decisions on public sector resource allocation will have to be guided by criteria other than economic. Decision makers will have to deal with this issue squarely and decide whether they will opt for cost-benefit or cosmetic analysis in influencing resource allocation among alternative uses.

^{46/} The viability of projects and/or policies are made at a point of time and any changes in relevant parameters that can be predicted should be incorporated in the economic analysis. Hybrid project cum-policy reform packages will necessarily have to follow a similar approach in their economic analysis.

VII. MAJOR RESEARCH ISSUES FOR IMPLEMENTATION

65. Given the definition of a project and a policy reform used throughout the paper, the analytical framework described is robust for integrating project and policy analysis. Its practical application will depend on devising simple procedures for estimating the major direct and indirect effects of projects and policy reforms and estimating the relevant shadow prices.

66. Much information regarding government taxation and sectoral policies is contained in shadow prices or conversion factors, and an analyst may gain valuable policy insights by simply comparing particular conversion factors with each other and with unity. Thus, a major research initiative is needed to estimate disaggregated conversion factors, both for the purpose of improving valuation procedures to be used in the economic analysis of projects as well as to provide indicators of the extent of distortions prevailing in various sectors of the economy. At the very minimum, partial equilibrium shadow prices should be updated.

67. Having estimated the extent of distortions which in itself is a major task, the next research issue is to identify the reason for the distortions. They could be due to either external trade or domestic distortions or both. The former has received a lot more attention than the latter in the development literature. The issue of domestic distortions arising out of market imperfections, government intervention and natural market failure warrants attention. The domestic distortions will affect the level and structure of domestic competition. While policy reform to correct for artificial market failure is relatively easy to design, natural market failure requires the design of complex optimal government intervention. The matching of policy instruments with targets crucially depends on diagnosing the reason for the distortion in terms of natural and artificial market failure. Research at this level would be invaluable in highlighting sectoral policy issues like the level of domestic competition which would have major implications for project viability and performance.

68. Once the extent of sectoral policy distortions and their cause are determined, policy reform programs need to be designed. There could be cases when economy-wide macro and micro measures like fiscal, monetary, trade and exchange rate policies have a much greater impact on sectoral efficiency than any or total microeconomic or sectoral measure. This is an area where research needs to be undertaken to assess effectiveness of sectoral policy reform in isolation as well as in combination with macro policy reform.^{47/} The interface of macro, sectoral and project level issues is likely to become increasingly important in the future.

^{47/} I. Ali, "Agricultural Price Policy in Asia: Issues and Areas of Reform, *Asian Development Review*, vol. 7, no. 1 (1989).

69. Related to the estimation of shadow prices is the issue of tracing the effects of a project or policy. In terms of input use, the semi input-output decomposition method advocated by Little and Mirrlees to take account of the linkage effects remains valid and relevant for both project and policy analysis. Empirical research in this area is relevant for both project and policy reform analysis.

70. On the output side, the impact of distortions on resource use needs close scrutiny and analysis. Here again tracing the effects becomes relevant. In principle, good project analysis should routinely do this. Since this has not been done in most cases, adoption of the practice will go a long way in improving the empirical and analytical content of project evaluation. In terms of the framework described in this paper, tracing the effects on the input and output sides will help determine the accompanying change in revenue used in estimating the shadow prices for non-traded goods and services.

71. Tracing the direct and indirect effects on the input and output sides amounts to the adoption of the Harberger framework where an element of welfare change associated with a project policy reform is represented by the sum of all induced changes multiplied by the degree of distortion in each market. This appears to be a practical way of finding a via-media between partial and general equilibrium frameworks since the most important indirect effects will be incorporated.

72. The importance of public utility and infrastructure projects, where costs are generally borne by the public sector while a large part of the benefits accrues to the private sector, will increase in many developing countries. This paper clearly shows that in such projects public utility pricing policy and shadow pricing rules are inseparable. As a first step, the most important fiscal effects of all projects should be estimated and reported. This should be followed by research for the estimation of the distortionary costs of taxation in developing countries.^{48/} Given the importance of the budgetary constraints in most developing countries, the importance of carefully analyzing and estimating the welfare costs of distortionary taxation cannot be overemphasized.

VIII. SUMMARY AND CONCLUSION

73. Augmenting capital accumulation was considered to be the central challenge for achieving growth in the developing countries in the 1960s and 1970s. Project investment constituted the cutting edge of development. To facilitate rational decision making for public sector investment, a vast literature on project evaluation emerged. Shadow

^{48/} There is a growing literature on the subject of the welfare costs of distortionary taxation. See C.L. Ballard, J.B. Shoven, and J. Whalley, "General Equilibrium Computations of the Marginal Welfare Costs of Taxes in the United States", *American Economic Review* 77 (1987); and E.K. Browning, "On the Marginal Welfare Cost of Indian Indirect Taxes", *Journal of Political Economy* 25 (1984).

prices defined as the ultimate effect on society's welfare resulting from a change in the net supply of an input or output featured prominently in this literature. A project that showed a profit at these shadow prices made a positive contribution to society's welfare. The debt crisis of the 1980s led to a decline in investment in many developing countries and attention shifted to the importance of macro and microeconomic policies in affecting growth. This shift was reflected in the growing recognition in the 1980s that policies, and not projects, were the cutting edge of development.

74. In the 1990s, both projects and policies will be important in determining growth in the developing countries. The volume and efficiency of investment will need to be carefully considered. Shadow prices and policy reforms will play a crucial role in this regard. Given budgetary constraints and the limits of governments in the growth process, public sector investment in many developing countries will be concentrated on infrastructure and public utilities. In these areas, three characteristics will be important, namely, non-tradeable outputs, public production and private consumption. In agriculture and industry, the role of the state would be to create a policy and institutional framework that would ensure competitive market conditions, correct market failure and provide the necessary incentives and investments in human resources, infrastructure and technology development.^{49/}

75. The main focus of this paper has been to demonstrate the need for making the choice of projects and the choice of policies within the same analytical framework. Shadow pricing rules depend on existing policies and any change in policies will influence the shadow pricing rules. Adjustments associated with policy reforms will often require investments to relax constraints and thereby raise supply elasticities. Both projects and policy reforms have the same objective - increased social welfare. Therefore, they should be chosen in such a manner that either singly or in unison the increase in social welfare should be maximum. In the ultimate analysis, the impact of projects and policies will be felt through resource reallocation for which a general equilibrium framework is required.

76. A major point of departure in the description of the shadow pricing rules is the explicit incorporation of the government budget constraint in the derivation of the rules. In the framework used, the partial equilibrium results that shadow prices equal border prices for tradeable and consumer prices for all non-tradeable and primary factors of production remain robust. Assuming the existence of lump-sum transfers, the general equilibrium framework yields shadow prices equal to border prices for tradeable and shadow prices equal to producer prices plus a term measuring the direct and indirect effects on the budget for non-tradeables. When lump-sum transfers are not possible to meet budgetary deficits caused by a project, the shadow prices are the sum of shadow prices for an economy where lump-sum transfers are possible plus

^{49/} I. Ali, *Designing Strategies and Policies for Managing Structural Change in Asia*, Economic Staff Paper no. 47 (Asian Development Bank, June 1990).

a term reflecting the welfare cost of distortionary taxes to adjust the budget.

77. The general equilibrium shadow prices incorporate some important effects. For example, a power project may have a low return if underpricing of electricity resulted in wasteful usage. This will be captured in the shadow pricing rules through the terms on the direct and indirect effects on the budget when non-tradeables are considered. In addition, if a subsidy is given to the use of the services produced by an infrastructure or public utility project and if distortionary taxes have to be used for meeting the cost of subsidy, the shadow pricing rules will capture this aspect. This highlights the proposition that public utility pricing policy and project appraisal results are inseparable.

78. A major result is that for projects whose outputs are non-tradeable, they are produced by the public sector and consumed by the private sector, the equilibrating mechanism or closure rules used to balance the government budget as a consequence of the project need to be explicitly considered in determining the shadow pricing rules. As far as public sector investment in many developing countries in the 1990s is concerned, the importance of this result cannot be overemphasized.

79. The generalized shadow pricing rules for non-tradeable incorporate interactions that are too complex to arrive at clear cut solutions. However, in a number of stylized cases, some implications of policy reform on project profitability emerge. First, any policy reform that reduces the welfare cost of distortionary taxation will, *ceteris paribus*, increase project profitability. Second, in public utility projects, a reduction in subsidy will, *ceteris paribus*, improve project profitability.

80. The analytical framework described is particularly suitable for assessing policy reforms. Starting from an initial environment which is not an optimum, information around the initial equilibrium can be used to determine desirable policy changes which are welfare improving. Piecemeal or phased policy reforms can thus be worked out. Given that both policies and projects are assessed within the same framework, a welfare change associated with an arbitrary project-cum-policy reform necessarily follows.

81. It is in moving from the analysis to the practical application that there will be a major challenge in devising simple rules of thumb which will be operationally useful yet theoretically robust. In this context, it should be noted that the distortions in an economy make it necessary to devise projects and policies where shadow pricing plays a critical role. On operational considerations, a *via-media* between partial and general equilibrium approaches needs to be determined. In this context, the literature on taxation provides some useful clues. Two aspects are relevant. First, the set of activities with significant distortions constitute a subset of all activities. Second, the set of activities whose levels are significantly affected by the projects and policies under study is another subset of the set of all activities. Only their intersection is important for the analysis of the effects of a specific project or policy or a combination of both. If the elements in

the intersection are of a manageable size, extensions from a partial equilibrium approach to incorporate the most significant elements will constitute a significant improvement over current practice. In the medium-term, this could be a feasible goal with only the most important direct and indirect effects being considered in assessing projects and policy reforms.

82. Research efforts are needed to improve the identification, quantification and valuation of benefits and costs in the with and without project and/or policy reform situations. Given the constraints on development resources, developing countries should devise their projects and policy reform packages in such a manner that the impact of the marginal resource on welfare improvement is the greatest.